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PMU-R1
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STERPMU-R1 RACK MOUNTED PMU

QUICK START MANUAL

STUDIO ELEKTRONIKE RIJEKA

WAMSTER
AD HOC PHASOR MEASUREMENT NETWORK

STER PMU-R1 Rack Mounted PMU Quick Start Manual rev. 1.1.2700 A5

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CE Mark on your equipment certifies that this equipment meets the requirements of the EU (European Union) concerning safety and interference causing equipment regulations

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1 Introduction

STERPMU-R1 is a rack mounted synchrophasor measurement unit, equipped with a rechargeable battery backup, GPS for time source, 10/100Mbps Ethernet link for up to 2 simultaneous C37.118.2-2011 links, GPRS modem for remote data reporting to the WAMSTER PDC system, controllable digital inputs and outputs, continuous waveform recording, harmonic analysis, and SD card slot for local storage of 5 months of synchrophasor measurements.

Combined with the WAMSTER cloud storage system, it provides instant web access to measured data through an ad-hoc, zero configuration network.



Figure 1.1: STERPMU-R1 device

Visit www.wamster.net/sterpmu-r1 to download the latest version of the STER PMU-R1 configuration application for Windows.

1.1 MAIN FEATURES

- 3 voltage channels, direct connection, three ranges (150V_{L-N}, 300V_{L-N}, 1000V_{L-N}), programmable ratio.
- 3 current channels, 1A nominal/2A peak (high precision range) or 20A nominal/32A peak (high current range), programmable range/CT ratio.
- Simultaneous 8 channels - 16bit AD conversion for accurate power measurements (minimal phase shift error).
- 4 digital inputs (220VDC) and 4 digital relay outputs (8A @ 250VAC, 0.5A @ 220VDC) accessible through C37.118.2 protocol extensions
- Ethernet (RJ-45) 10/100Mbps port for C37.118.2 links
- GPRS/UMTS modem provided for simultaneous reporting to the WAMSTER PDC over the mobile network.
- RS-232 configuration port included for device configuration and troubleshooting using a Windows-compatible application (USB to serial adapter cable included).
- Installed 32GB local storage for synchrophasors, waveforms and harmonics.
- Installed rechargeable battery backup for 4 hours of autonomy.
- Configurable local event triggering system and additional WAMSTER near-real time event triggering system.

1.2 SAFETY CONSIDERATIONS

To ensure operator safety while using the STER PMU instruments and to minimize the risk of damage to the instrument, please note the following general warnings:


The instrument is designed to ensure maximum operator safety. Usage in a way other than specified in this manual may increase the risk of harm to the operator!


Do not use the instrument and/or any accessories if there is any damage visible!


The instrument contains no user serviceable parts. Only an authorized dealer can carry out service or adjustment!


All normal safety precautions have to be taken in order to avoid risk of electric shock when working on electrical installations!


Only use approved accessories available from your distributor!


Instrument contains rechargeable batteries for auxiliary power supply. Batteries are not user serviceable.


Hazardous voltages exist inside the instrument. Before any installation or deinstallation, make sure to disconnect all test leads, remove the power supply cable and switch off the instrument.


Maximum voltage between any phase and neutral input is 1000 V_{RMS}. Maximum voltage between phases is 1730 V_{RMS}.


Always short unused voltage inputs (L1, L2, L3, GND) with the neutral (N) input to prevent measurement errors and false event triggering due to noise coupling.

1.3 APPLICABLE STANDARDS

STER PMU device is designed and tested in accordance with the following standards:

Electromagnetic compatibility(EMC)	
EN 61326-2-2: 2006	Electrical equipment for measurement, control and laboratory use. Emission: Class A equipment (for industrial purposes) Immunity for equipment intended for use in industrial locations
Safety (LVD)	
EN 61010-1: 2001	Safety requirements for electrical equipment for measurement, control and laboratory use
Measurement methods	
TBD	

NOTE ABOUT EN AND IEC STANDARDS:

Text of this manual contains references to European standards. All standards of EN 6XXXX (e.g. EN 61010) series are equivalent to IEC standards with the same number (e.g. IEC 61010) and differ only in amended parts required by European harmonization procedure.

2 Overview

2.1 FRONT PANEL

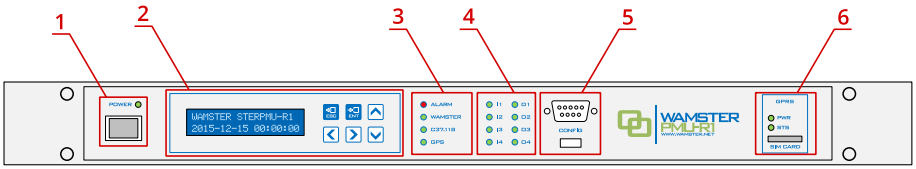


Figure 2.1: Front panel

Front panel layout:

1	Power button and status LED
2	Backlit LED display (2 x 20) with keyboard
3	General Status LEDs (Alarm, Wamster link, C37.118 Link, GPS status)
4	Digital input/output status LEDs
5	Configuration port (DE-9 RS232), service port (USB micro B)
6	SIM card slot and status LEDs (Modem power/status)

2.2 REAR/CONNECTOR PANEL

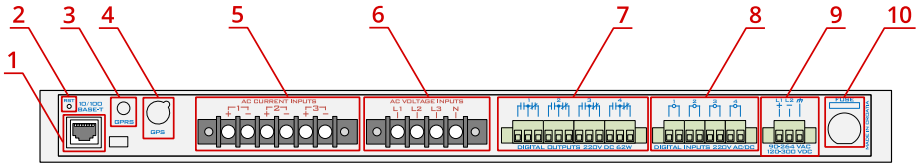


Figure 2.2: Top connector panel

Rear panel layout:

1	RJ-45 Ethernet socket
2	Reset button
3	GPRS antenna socket
4	GPS receiver port
5	AC current input terminals, 3 channels (1, 2, 3)
6	AC voltage input terminals, 3 channels (L1, L2, L3, N)
7	Binary output terminals, 4 outputs (O1, O2, O3, O4), NO+NC 8A @ 250VAC, 0.5A @ 220VDC
8	Binary input terminals, 4 inputs (I1, I2, I3, I4), 220V AC/DC
9	Power supply terminals (90-264 VAC, 120-300 VDC)
10	Safety fuse

3 Device configuration

3.1 CONFIGURING THE DEVICE FOR FIRST USE

3.1.1 CONFIGURATION TOOL

STERPMU-R1 is easily configured through the WAMSTER PMU Configuration Tool, a Windows application which connects to the device through the front DE-9 (RS-232) port.

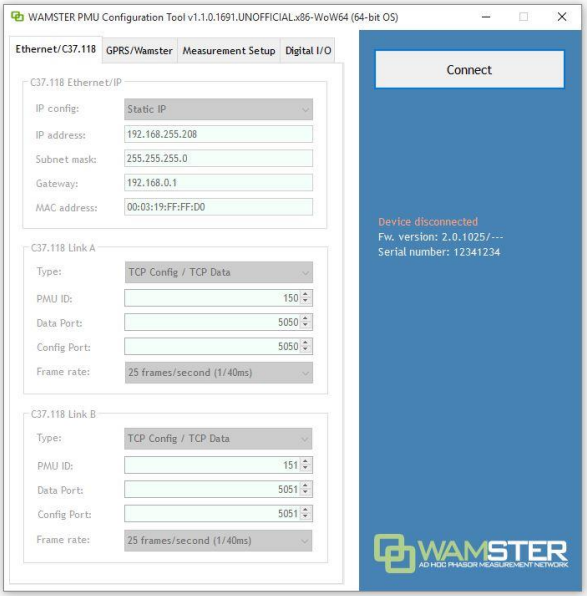


Figure 3.1: Configuration Tool

Latest version of the tool can be found online at www.wamster.net/sterpmu-r1. After downloading, run `setup.exe` and follow the instructions on how to install the application.

Configuration Tool requires a Windows OS with Microsoft .NET Framework version 4.6.2 installed. Setup program will prompt you to install this version of .NET if it isn't already installed.

3.1.2 CONNECTING THE DEVICE TO A PC

STER PMU-R1 uses the DE-9 connector on the front panel for the serial (RS-232) connection with the configuration tool. Use the supplied USB-to-Serial adapter cable to connect your PC to the device.

Plug one side of the cable into the DE-9 port, shown in red in the following picture:



Figure 3.2: Configuration port on the front panel

Plug the USB side of the cable into the computer. If this is the first time you are connecting this cable, Windows will finish driver installation. This may finish almost instantly on some systems, or take several minutes on other.

3.1.3 STARTING THE CONFIGURATION TOOL

After the driver has been installed, start the WAMSTER STER PMU-R1 Configuration Tool by double-clicking the desktop icon, or launch the application through the Start menu. To connect to the device, click the Connect button on the top right side of the window.

Connect dialog will be shown, allowing you to choose the port name. Leave Connection Type to **Serial (RS232)**, and select the correct COM port name.

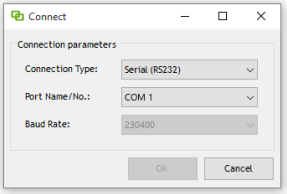


Figure 3.3: Connect dialog box, showing available COM ports

Most computers without a built-in RS232 port will only show a single selection, corresponding to the USB-to-Serial adapter. However, some computers might offer several COM ports to choose from. If you are not sure, try unplugging the cable from the computer and see which COM port will disappear from the list. Alternatively, try connecting to each port until you detect the USB-to-serial connector.

Once the connection is established, firmware version will be displayed on the right side of the window, and the tool will read the current device configuration and display it inside the tabs on the left side. This means the settings are ready for editing.

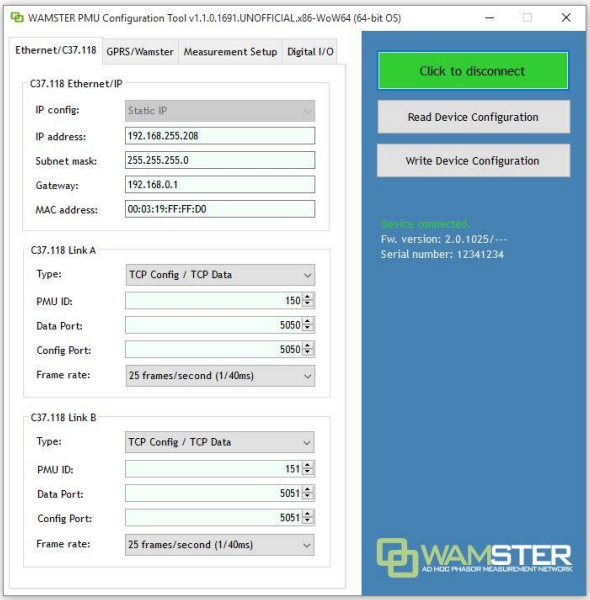


Figure 3.4: Configuration port on the front panel

Depending on the firmware version, some settings might be disabled (read-only).

Once the device is connected and current device configuration has been received, use the text inputs on the left side to enter settings. Inputs are organized into tab groups, explained in the following chapters.

3.1.4 ETHERNET/C37.118 SETTINGS

The first tab shows settings needed for the C37.118 links to the PMU device over the TCP/IP link, through the Ethernet port on the back panel. Use the inputs to configure the IP address/subnet of the PMU device, as well as PMU stream IDs and port numbers for incoming links.

These setting must match the settings on the PDC device(s). If the PMU and PDC are not on the same subnet, proper routing and port forwarding must be configured on the intermediate equipment.

C37.118 Ethernet/IP settings

IP config	*[read-only]* Currently only Static IP is supported (DHCP is not supported).
IP address	Static IP address of the PMU device.
Subnet mask	IP subnet mask.
Gateway	IP address of the gateway. This is only needed if PMU will initiate connections to IP addresses outside the subnet range (usually PMU is the server, accepting connections from the PDC).
MAC address	Device MAC address. This is factory configured using the device serial number, and only needs to be change if there is a known collision with another device on the subnet.

C37.118 Link A/Link B

Type	Currently supported: ▪ Disabled (PMU will not accept connections on this link) ▪ TCP config/TCP data (one TCP/IP port will be used per PDC connection, for its config and data streams)
PMU ID	Stream ID for this link. This value must match the PDC stream ID.
Data port	Incoming TCP/IP port for the data stream.
Cfg port	*[read-only]* Incoming TCP/IP port for the config stream. Equal to data port when TCP config/TCP data is selected.
Frame rate	Data transmission frame rate, from 1 per second to 50 per second.

3.1.5 GPRS/WAMSTER SETTINGS

The second tab contains settings for the mobile GPRS link to the WAMSTER server. This allows extended information about the device, including remote management, download of oscillograms/harmonics on request, and data analysis using the WAMSTER web interface.



Before configuring the GPRS/WAMSTER settings, a SIM card with an active data plan must be inserted. Furthermore, it is **advisable to turn off PIN protection on the SIM card** by inserting in a phone.

WAMSTER Link: GPRS modem

APN	APN (Access Point Name) for the GPRS link.
PIN	SIM card PIN. It is recommended to leave this field blank if the SIM is unlocked. Using the incorrect PIN value will lock the SIM card.
Username	Username for the GPRS link. Leave blank if not used.
Password	Password for the GPRS link. Leave blank if not used.

WAMSTER Link: Server settings

PMU ID	*[read-only]* WAMSTER PMU ID, read-only. This ID is used for the mobile link to the WAMSTER server and is not related to C37.118 streams. Use this ID to identify this PMU when accessing the WAMSTER web interface.
WAMSTER Host	*[read-only]* WAMSTER server host or IP address. Default value is *pdc.wamster.net* for the link to the main WAMSTER server.
WAMSTER Port	*[read-only]* WAMSTER server target port. Default value is 5000.

Device information

Serial number	*[read-only]* Device serial number.

3.1.6 MEASUREMENT SETUP

The third tab contains settings related to measurement channels, like voltage/current ranges and transformation ratios.

STER PMU-R1 can be connected to a LV, MV or HV power system using different voltage ranges. Three voltage ranges for each wiring configuration (4W or 3W) are available, described in the following tables:

Table 3.1: 4W measurement ranges

Range name	Default nominal voltage	Clipping amplitude	Meas. type	VT connection	Power system
150 V_{L-N}	110 V_{L-L} (64 V_{L-N})	235 V_{L-N}	direct / indirect	CONFIGURABLE	LV/MV/HV
300 V_{L-N}	400 V_{L-L} (230 V_{L-N})	500 V_{L-N}	direct	N/A	LV
1000 V_{L-N}	1000 V_{L-L} (580 V_{L-N})	2205 V_{L-N}	direct	N/A	LV

Table 3.2: 3W measurement ranges

Range name	Default nominal voltage	Clipping amplitude	Meas. type	VT connection	Power system
260 V_{L-L}	110 V_{L-L}	410 V_{L-L}	direct / indirect	CONFIGURABLE	LV/MV/HV
520 V_{L-L}	400 V_{L-L}	865 V_{L-L}	direct	N/A	LV
1700 V_{L-L}	1000 V_{L-L}	3815 V_{L-L}	direct	N/A	LV

Nominal voltage is always specified as **line voltage**, even on 4W measurement ranges where the range name is specified as phase voltage. Default nominal voltage value is provided depending on the selected range and can be changed by the user, **unless** voltage transformer (VT) ratio is specified – in that case it is fixed and equals the voltage value of the transformer primary side.



Always select the lowest range name with value equal or higher than the nominal input voltage; peak phase voltages in the table above should **not** be considered when choosing the range. For example, for 230VAC single phase measurement, range 150 V_{L-N} should **not** be used as it doesn't provide the necessary range for the 230VAC nominal phase voltage. Similarly, although the 1000 V_{L-N} range would provide the necessary range for measuring 230VAC, range 300 V_{L-N} would provide **better resolution** in this case.

Apart from setting the correct range to get best possible resolution without clipping, setting the **correct nominal line voltage** is important for correct *per unit* (pu) voltage calculation used in WAMSTER event triggering and online analysis.

The following table lists the available settings:

Measurement Setup: Voltage inputs

Wiring Config	▪ 4W – use for 3-phase 4-wire systems (with neutral) ▪ 3W – use for 3-phase 3-wire systems (without neutral)
Input range	One of the three voltage ranges (see tables 3.1 and 3.2.)
Nominal line voltage	Nominal voltage (specified as line voltage). This value is read-only if VT (voltage transformation) is enabled (in that case it is set to the primary transformer voltage).
VT enabled	If checked, voltage transformation ratio will be applied.
VT ratio	If VT enabled is checked, VT ratio can be specified. Nominal line voltage will be set to the primary side voltage.

Measurement Setup: Current inputs

Input range	▪ 1A nominal current (max 2A RMS) – high resolution range. Use if peak RMS current won't exceed 2A. ▪ 20A nominal current (max 32A RMS) – high current range. Use if 2A RMS is not enough.
CT ratio	Current transformation ratio.

Measurement Setup: Frequency

Grid frequency	Choose between 50 or 60 Hz.
Frequency sync	Frequency synchronization source: Voltage or Current. This is the channel which be used for frequency estimation. It is recommended to set to Voltage, unless only the current inputs are connected.
Frequency calc	Frequency calculation algorithm: Single phase (L1) or Symmetrical (3-phase). Symmetrical will provide better frequency estimation for symmetrical 3-phase systems, but incorrect results if the system is not symmetrical.

3.1.7 DIGITAL I/O SETUP

The last tab contains settings related to the control of STER PMU-R1 digital outputs.

Each digital output can be configured to work in two modes:

1. Remote activation: this allows closing and opening the contact through the GPRS link (using the WAMSTER web interface), or through the WAMSTER C37.118 extended frames over Ethernet.
2. Local PMU control: in this mode, PMU sets the state of the specified digital output according to one of its internal states.

STER PMU-R1 supports the following status signals:

1. **GPS time source synchronization (NC)**: closed if the device is online and is synchronized with an external GPS time source.
2. **Ethernet cable status (NC)**: closed if the device is online and can detect a valid Ethernet link.
3. **C37.118 PDC connected (NC)**: closed if the device is online and at least one PDC is connected to the PMU.
4. **No alarms (composite status, link + GPS sync) (NC)**: closed if the device is online, synchronized to the GPS link, and at least one PDC device is receiving data.

If the outputs are configured for Remote activation (PDC), they can also be opened and closed using the configuration tool, by clicking the 0 and 1 buttons respectively in the Digital Outputs group box:

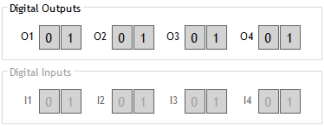


Figure 3.5: By clicking the 0/1 buttons in the Digital Outputs group box, it is possible to control (open/close) actual PMU binary outputs

Warning! If an output is set to PDC (remote activation mode), clicking these buttons will immediately change its status. If the PMU is already installed and the outputs are wired, care must be taken not to damage other equipment.

3.1.8 WRITING THE CONFIGURATION TO THE DEVICE

Click the Write Device Configuration button on the right side of the window to send the configuration to the PMU.

Once the device receives all settings, the tool will prompt you to send the reset command to the PMU device. Click OK to reboot the device and finalize configuration. Before rebooting, STER PMU-R1 will store the settings in its non-volatile memory.

The device is not fully configured until it is rebooted. Skipping the reset sequence will leave the device in an undefined state.

To fix incorrectly entered settings, click the Read Device Configuration button to read the latest settings from the device again, then modify the settings as needed.

4 Working with the device

4.1 GENERAL CONSIDERATIONS FOR WIRING

Although the STER PMU-R1 can be accessed remotely to change configuration settings, it is nevertheless important to configure the wiring properly if the device is intended to run during longer periods of time, at a distant location.

- Make sure that phases are **correctly connected**. To avoid confusion, current connector I1 and voltage connector L1 should be connected to the same phase.
- Check the direction of the **current flow**. Current transformers should be mounted to measure the positive direction of the current flow, from supply to load.
- Under the influence of parasite impedances, voltage terminals which are not connected (floating inputs) can falsely measure unrealistically **high values**, creating large reading errors. It is therefore recommended to connect (short-circuit) all unused terminals to the neutral connector.
- Frequency estimation is done presuming a 3-phase system. If phases L2 and L3 are not used, they should be **connected to the neutral terminal**.



If 3W frequency measurements appear incorrect, check that the SYNCHRONIZATION setting is set to U1, and that voltage phase channels are not swapped (rotated). **All unused voltage channels should be connected to the neutral terminal.**



Note that the **Neutral terminal (N) is the reference potential terminal for all voltage measurements**, when measuring in 4W measurement mode (L1-N, L2-N, L3-N).

4.2 STATUS DIODES

There are four status diodes on the front panel:

1. **ALARM (red)** indicates active or unacknowledged alarms:

Off	No alarms. Device has a valid GPS time synchronization and a valid C37.118 link and is sending data frames to a PDC.
Blinking red	Alarm currently active (GPS error, or PDC not connected, or power supply error).
Solid red	Alarm inactive but not acknowledged. Use the ALARM screen in the STATUS menu to acknowledge the alarm.

2. **WAMSTER (green)** indicates WAMSTER link status:

Off	Not connected to WAMSTER. Check the WAMSTER screen in the STATUS menu for more information.
Solid green	Connected to WAMSTER.

3. **C37.118 (green)** indicates C37.118 link status:

Off	Configuration error. Use the PC configuration tool to upload C37.118 settings to the device.
Blinking green, 1s period	Ethernet cable disconnected.
Blinking green, 0.5s period	Ethernet cable is connected, but network is not yet identified.
Blinking green, 0.25s period	The device is waiting for connections from the PDC on the configured ports.
Solid green	At least one C37.118 link is active.

4. **GPS (green)** indicates GPS receiver status:

Off	GPS receiver is not connected or cable faulty.
Blinking green, 1s period	Cable is connected, but no signal yet.
Blinking green, 0.5s period	GPS receiver is sending the synchronization pulse, but the timestamp is not reliable. Make sure the GPS receiver is placed at a location with an open sky view.
Blinking green, 0.25s period	GPS receiver pulse is noisy, or there are not enough visible satellites.
Solid green	Valid GPS time: receiver is sending pulses and synchronized timestamps.

4.3 DIGITAL I/O DIODES

Digital Input/Output diodes on the front panel display statuses of the binary inputs and outputs. Using the PC configuration tool, it is possible to assign binary outputs to different PMU status signals, as explained in the previous chapter.

4.4 OPERATING THE LCD INTERFACE

Using the LCD and keys on the front panel of STER PMU-R1, it is possible to display currently measured values, statuses of the device components and acknowledge alarms.

There are two main menus accessible from the MAIN Screen: METER and STATUS. To access the METER screen, press Enter (ENT). Then use the left and right arrow keys (<, >) to switch between METER and STATUS menus, as shown in the figure:

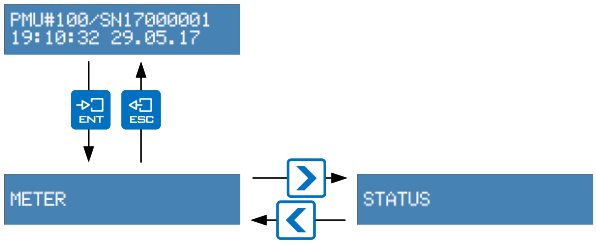


Figure 4.1: Accessing the METER and STATUS menus

4.4.1 METER MENU

When the METER menu is shown, press Enter (ENT) to show the VOLTAGE measurement screen. Then use the left and right arrow keys (<, >) to switch between VOLTAGE and CURRENT screens:

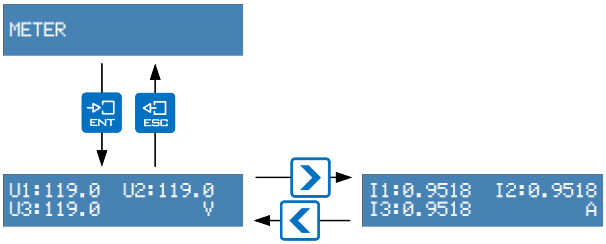


Figure 4.2: Accessing the VOLTAGE and CURRENT measurement screens

To return to the METER menu, press the Escape key (ESC).

4.4.2 STATUS MENU

STATUS menu contains several status screens, which can be accessed by pressing the Enter key (ENT), and navigating using left and right arrow keys (<, >):

- **WAMSTER LINK**: shows the initialization steps for the GPRS mobile link:
  - INITIALIZATION 00 to 01 – internal modem initialization.
  - INITIALIZATION 02 to 10 – network detection and registration.
  - INITIALIZATION 11 to 14 – SIM card initialization. If the device is stuck here, check if the SIM card is properly inserted.
  - INITIALIZATION 15 – PIN unlocking. If the SIM card is PIN-protected and a PIN has been specified, device will try to unlock the SIM in this step. If this step is failing, check that (i) the SIM card PIN protection is enabled and you have the corrected PIN, or (ii) the SIM card PIN protection is disabled and the specified PIN is empty. Note that the SIM card might get locked if the device made 3 incorrect PIN attempts, after which it will need a PUK key to unlock.
  - INITIALIZATION 16 to 17 – connecting to the mobile network. If the device is unable to complete these steps, check that the modem antenna is properly connected and try to place it at a different position. If the device was disconnected for a longer period, these steps might take longer to complete.
  - INITIALIZATION 18 to 20 - APN, username and password configuration. Check if APN, username and password are correctly configured using the PC config tool.
  - INITIALIZATION 21 to 23, CONNECTING, CONNECTED – final steps before connecting to the server. If these final steps are failing, the device is unable to reach the WAMSTER server. The server might be temporarily offline.
- **C37.118 LINK**: shows the status of the C37.118 links from a PDC to the PMU:
  - CONFIG ERROR: incorrect C37.118 settings. Use the configuration tool to configure the device.
  - ETH. CABLE ERROR: ethernet cable is disconnected or faulty.
  - ETH. CABLE OK: ethernet cable is connected, but network is not yet identified.
  - ETH. LINK READY: the device is listening for connections from the PDC.
  - PDC CONNECTED 1/2: one or two PDC links have been established.
- **GPS STATUS**: shows the status of the GPS receiver:
  - NO DEVICE: GPS receiver is not connected or cable faulty.
  - DEVICE DETECTED: cable is connected, but no signal yet.
  - PPS DETECTED: GPS receiver is sending the synchronization pulse, but the timestamp is not reliable. Make sure the GPS receiver is placed at a location with an open sky view.
  - SIGNAL NOISE: GPS receiver pulse is noisy, or there are not enough visible satellites.
  - PPS & MSG VALID: GPS is sending pulses and valid synchronized timestamps.
- **ALARM**: shows the status of the alarms, and allow alarm acknowledgement:
  - ALARM ACTIVE: one or more alarms are currently active and need to be resolved.
  - ALARM NOT ACK'D: alarm is not active but needs to be acknowledged. Press ENT to acknowledge the alarm. The ALARM LED should turn off.
  - ALARM NOT ACTIVE: no active alarms, all previous alarms have been acknowledged.
- **DEVICE INFO**: displays the device model and firmware version number.

STATUS menu hierarchy is shown in the following figure:

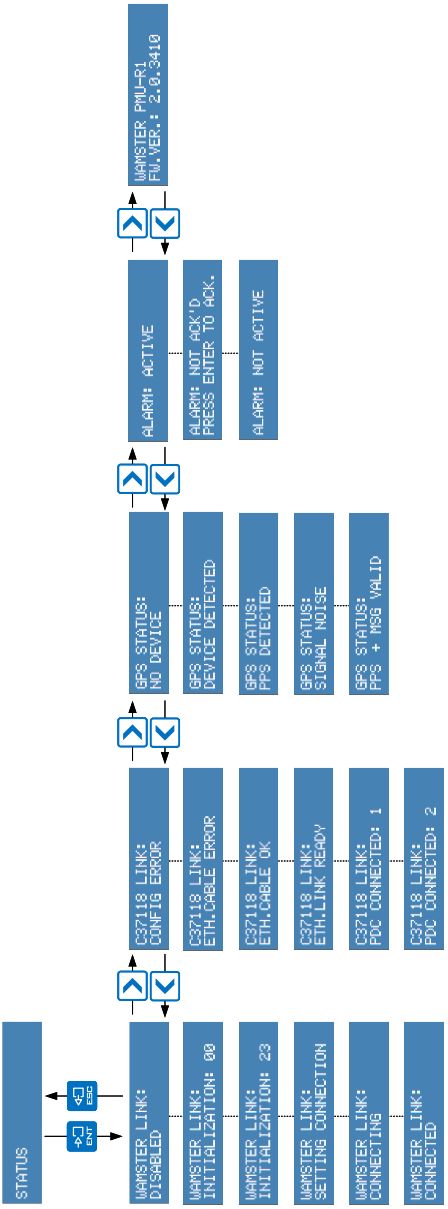


Figure 4.3: Accessing the VOLTAGE and CURRENT measurement screens

4.5 MANAGING THE DEVICE USING THE WAMSTER WEB INTERFACE

After the device has been connected, it can be managed through the Wamster web interface. To access the web interface, please visit www.wamster.net/users and log in using provided credentials.

After logging in, web interface should display statuses and management options for devices registered under your username. If some of the devices are not being shown, please contact the distributor to associate these devices with your account. During the installation and commissioning, it is useful to have a web enabled device and monitor the device status online, as it can provide additional details about the GPS status, wiring and scaling, and other information.

For detailed help on using the online web interface, please consult chapter 5: *Using the Wamster web interface*.

5 Using the Wamster web interface

After the device has connected to the server, it can be monitored and managed through the Wamster web interface.

Wamster web interface provides a simple way to monitor and configure your device, as well as download (export) measured data from the cloud storage.

5.1 MINIMAL CONFIGURATION

To access the Wamster, you will need a web enabled device (personal computer, a tablet, or a smartphone) with an installed web browser and JavaScript enabled.

Although Wamster uses standard-compliant web technologies in order to support a wide range of Internet browsers, some browsers (like Microsoft Internet Explorer prior to version 10) do not fully conform to www standards. While they are officially supported by Wamster, using one of the following browsers is recommended for safety, speed and better browsing experience (newest download links shown for each browser):

- Google Chrome 9 or newer: www.google.com/chrome
- Mozilla Firefox 3.6 or newer: www.getfirefox.com
- Microsoft Internet Explorer 10 or newer: www.microsoft.com/windows/downloads/ie
- Opera 10 or newer: www.opera.com/download
- Apple Safari 5 or newer: www.apple.com/safari

5.2 SIGNING IN TO WAMSTER

To access the web interface, visit www.wamster.net/users using a web browser of your choice. If you were not previously signed in, you will be asked for your credentials.

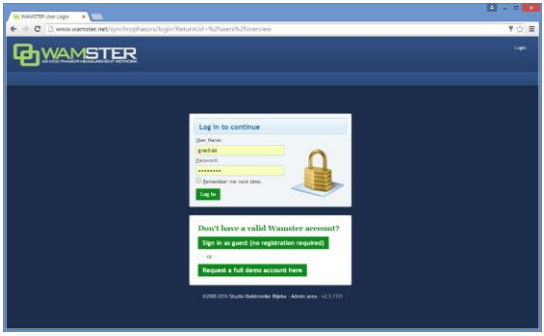


Figure 5.1: Authentication form shown when accessing Wamster

In order to sign in, you will need a username/password combination provided to you via e-mail. If you enter an incorrect password several times, your account may be locked out. If you believe your account has been locked, or have any troubles signing in, please contact us at support@wamster.net to resolve this issue.

If signed successfully, you will be redirected to the **Overview** page. Navigation menu will be changed to include advanced options, and user status will be shown in the upper right corner:

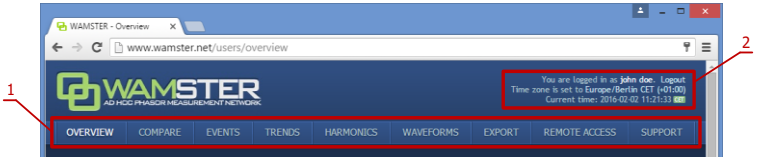


Figure 5.2: User area: 1. navigation menu, 2. login status / Logout link / Time zone settings

After logging in, at the top of each Wamster there is the navigation menu (marked with 1 on the figure above), providing access to different pages, and the user status/time area (marked as 2).

To log out, click the Logout link button in the upper right corner of the web page. This area will also show current server time, shown in your browser's reported time zone. To use a custom time zone, click on the zone name in the upper right corner to show a list of zones. This setting is stored as a site-wide cookie and is respected across the entire Wamster site.

If your local browser's time differs by more than 5 minutes compared to the server time, it will be shown in red to indicate that you need to synchronize your local time. Having your local clock synchronized with the server improves Wamster experience when examining online trends and comparing devices.

5.3 OVERVIEW

First navigation item and the default page after logging in is the Overview page, which shows a general overview of your devices. Statuses and management options for individual devices registered under your username can be seen, as shown on the figure:

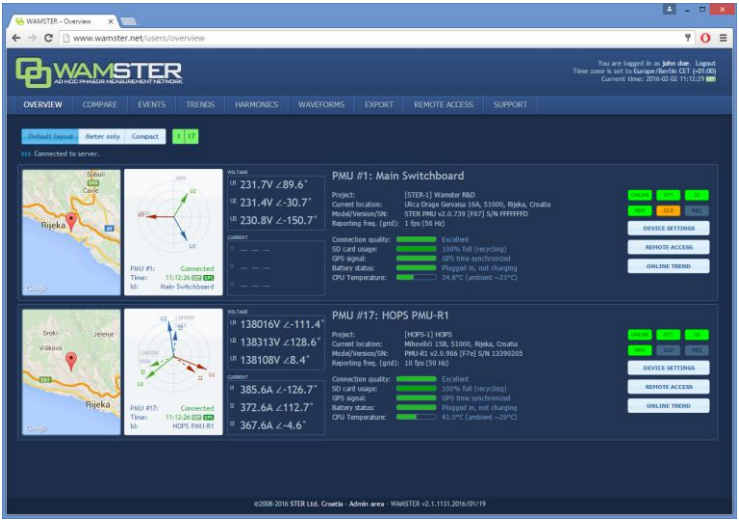


Figure 5.3: Overview page, showing devices for the currently logged in user

Measurements from multiple devices shown in the Overview page are **not** displayed with a synchronous timestamp, i.e. each device can have a different timestamp depending on network conditions. To perform a synchronized comparison, use the **Compare** or **Map** pages, described in the following chapters.

For each device there is a separate panel showing various status indicators:

- phase diagram with voltage and current vectors (near real-time),
- map indicating the device location as reported by the GPS device,
- device ID, custom name and address as reported by its GPS device
- device model, serial number and firmware version
- nominal grid frequency [Hz] and current reporting speed [fps]
- connection quality, SD card usage info and GPS signal information

On the right side of each panel, there are several visual status indicators and buttons for accessing device settings:

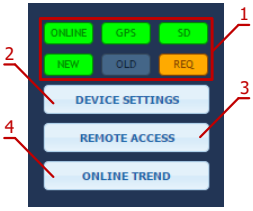


Figure 5.4: Visual status indicators and command buttons

Visual status indicators and command buttons:

1	Status indicators	First row of indicators shows statuses: ▪ ONLINE: when green, device is connected ▪ GPS: when green, GPS reliable ▪ SD: when green, SD card inserted and functional Second row of indicators blink to indicate that the communication is live: ▪ NEW: if green, up-to-date synchrophasor frame received ▪ OLD: if orange, frame has been received from instrument's local memory ▪ REQ: if orange, there is a pending request for old frames (either because of a bad data connection, or because user requested frames at a different reporting rate)
2	Device Settings button	Clicking on this button opens the Device Settings form, which can be used to configure the device
3	Remote Access button	Clicking on this button shows the Remote Access page, which can be used to connect to the instrument and operate it remotely
4	Online Trend button	Clicking on this button shows the Trend page in Online mode, with this device selected. This allows users to quickly get a recent measurements trend (last 5 minutes).

To change the custom name of a device and its reporting frequency, click on the Device Settings button to open the Device Settings form.

Depending on granted user access privileges, some buttons might be disabled (grayed-out). Users usually have administrative access rights for their owned devices, but may also have read-only devices from STER for reference or demonstration purposes.

5.3.1 DEVICE SETTINGS FORM

Device Settings form is the central place for changing all user applicable device settings. At the top of the dialog (shown in figure 6.5) there are tabs which are used for switching between various settings panels (marked as 1 in the figure).

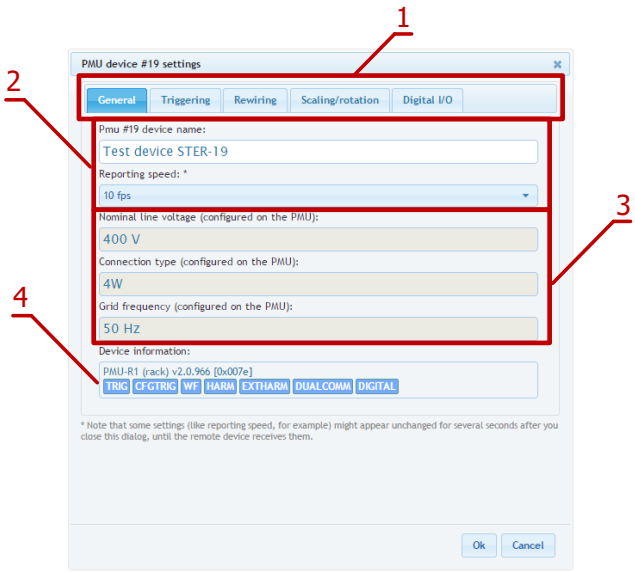


Figure 5.5: Device Settings form can be used to change the various device settings

5.3.2 GENERAL SETTINGS

Fields marked with (2) on the image are used to change device's name and reporting speed.

Reporting speed is the default number of data frames per second that this device should send to the server, under normal operating conditions. During triggered events, or on user request, server can automatically increase this value to get full resolution (synchronized) historical data from the device. Likewise, when mobile network conditions are inadequate, server can temporarily reduce the real-time reporting speed until the connection permits the user specified reporting speed.

To learn more about the Wamster communication protocol, please consult online manuals and whitepapers at www.wamster.net, specifically the Wamster System Implementation Details whitepaper. Additional whitepapers, datasheets and catalogs can be found at www.wamster.net/w2/features/wamster-whitepapers-datasheets-catalogs.

Settings marked with "3" (Nominal line voltage, Connection type and Grid frequency) cannot be changed online, they are configured on the PMU and sent to Wamster. Note that Nominal voltage is always specified as *line* voltage, regardless of the connection type.

Final group in this tab, marked with "4", indicates the type of your PMU device, its firmware version, and currently enabled functionalities:

1	TRIG	**Triggering**: Device supports local triggering with fixed (PMU side) thresholds. PMUs with local triggering detect several event types and report them to the server, which then requests these data frames at full resolution for further processing. This allows the user to lower the default reporting speed while still getting sub-second events when they happen.
2	CFGTRIG	**Configurable triggering**: Device supports local triggering with configurable (server side) thresholds. This is an extension of the TRIG functionality, where thresholds can be configured inside the device settings form. If this option is not enabled, device used default thresholds (+/- 10% Voltage, +/- 0.1 Hz frequency).
3	WF	**Waveform Recorder**: Device performs continuous 8-channel waveform (oscillogram) recording. If this functionality is enabled, the device will continuously record waveform data and store it locally (4.5 days of measurements on 32GB cards). It will also reserve most of the external SD card memory for oscillograms, so local PMU data will also be kept for 4.5 days (32GB). During events, or on user request, oscillograms will be downloaded to the server.
4	HARM	**Harmonic Aggregates**: Device records 10-minute harmonic aggregates (min, max, avg) for all channels, for up to 30th harmonic + THD. If this functionality is enabled, server will automatically retrieve harmonics at the end of each aggregation period. This functionality uses internal flash memory to store 10-min aggregates for the period of 17 hours.
5	EXTHARM	**Extended Harmonics**: Improved harmonics recorder, stores 10-min aggregates for the last 17 days.
6	DUALCOMM	**Dual Communication Module**: Device is equipped with a communication module capable of simultaneously transmitting data using two protocols (WAMSTER and C37.118), to different targets, Ethernet + GPRS. This feature is useful when the project requires simple integration with standard C37.118 PDCs, but additional Wamster features also need to be utilized.
7	DIGITAL	**Digital I/O**: PMU device is equipped with digital inputs and outputs, which can be monitored and activated from the Wamster server programmatically.

Some settings (like reporting speed, for example) might appear unchanged for several seconds after the dialog is closed, until the remote device receives them. Note also that the form contains Measurement setup settings intended to allow post processing (scaling and phase swapping) of signals. This feature is currently reserved for future use and can be enabled on request.

5.3.3 LOCAL TRIGGERING

If the PMU device supports the CFGTRIG functionality, Triggering tab can be used to configure local thresholds, as shown in the figure below. Each triggering rule can be enabled or disabled separately by selecting the checkboxes above low/high threshold input boxes.

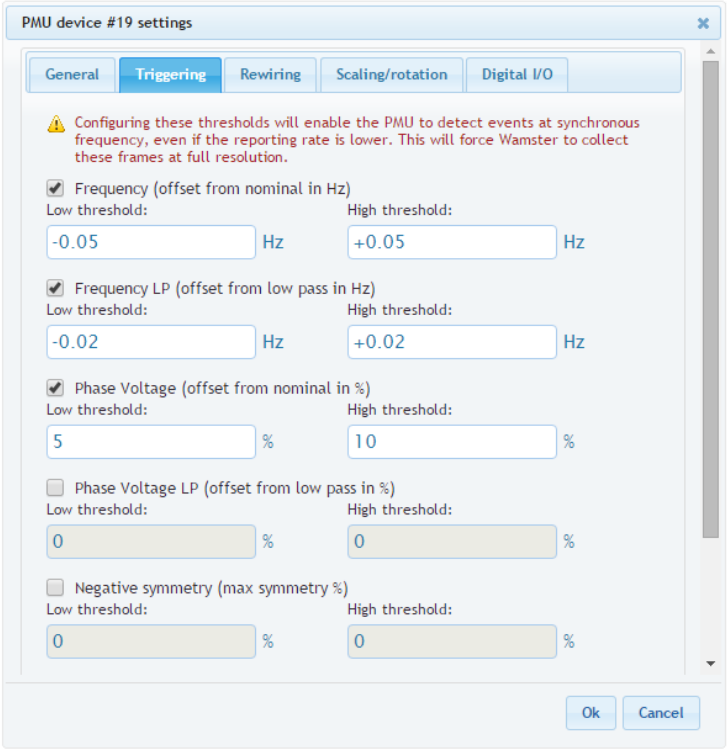


Figure 5.6: Triggering tab enables configuration of local (PMU side) event triggering

Thresholds for voltage-related quantities is specified as p.u. (percent of nominal value), where the nominal value is configured on the device and can be seen on the General tab.

Local triggering thresholds are separate from Wamster's event triggering system (which is applied to incoming measurements). These settings are uploaded to the PMU device so that the device itself can perform them locally, on synchronized data, and report detected events to Wamster. **Additional information about the PMU local triggering system can be found in the chapter** Error! Reference source n ot found. *Error! Reference source not found.*.

5.3.4 REWIRING RULES

Using the Rewiring tab, each of the 8 input channels (U1-U4, I1-I4) can be rewired (routed) to a different channel, or disabled (disconnected):

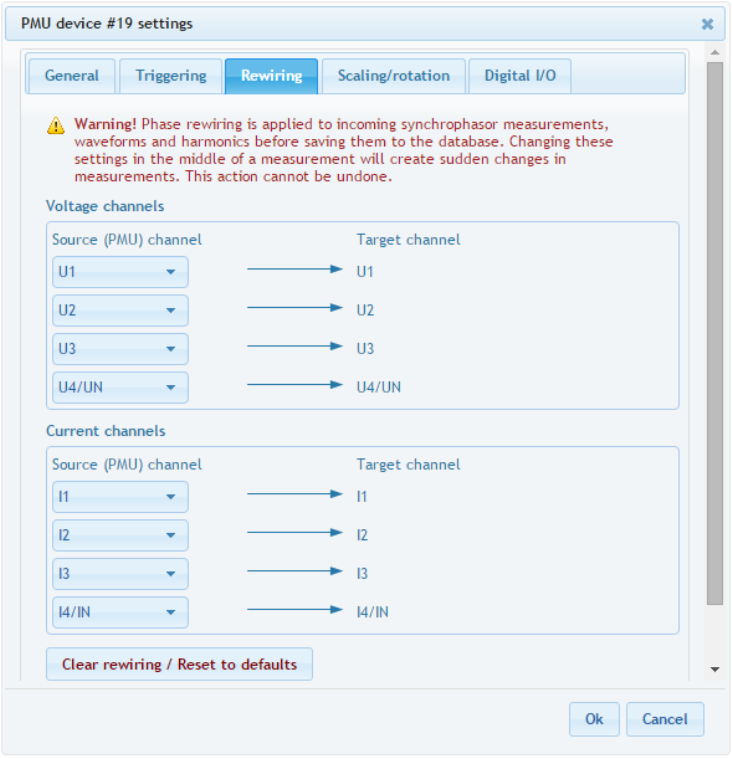


Figure 5.7: Using the Rewiring tab, it is possible to disable certain channels, or correct wiring and rotation

Rewiring is applied to all incoming measurements, including synchrophasors, waveforms and harmonics. A single source channel can also be duplicated, i.e. routed to multiple different target channels, each of which will act like a separate channel for analysis, triggering or export. To quickly clear all rewiring rules to default, use the Clear rewiring / Reset to defaults button at the bottom of the panel.



It is recommended to hide channels which are not physically connected anywhere, by setting their source to *Not connected*. Unconnected channels can pick up noise, so disconnecting them through the interface will make analyzing other channels easier and more readable.

For more complex scaling and rotation corrections, the Scaling/Rotation tab can be used, but rotation (phase angle) corrections on that tab are applied only to synchrophasors data.

5.3.5 SCALING/ROTATION SETTINGS

To add different scaling or apply phase angle corrections to each channel, use the Scaling/Rotation tab.

Input channels in the Scaling/Rotation tab are rewired output (target) channels from the Rewiring tab, not actual channels from the PMU device.

Scaling settings (along with rewiring on the previous tab) are applied to all measurements, but rotation settings (angle corrections) are **only applied to synchrophasors**. Harmonic aggregates and oscillograms (waveforms) are not affected by these settings. This can result in inconsistencies between measurements and must be taken into account when analyzing waveform data collected from the PMU device.



Figure 5.8: Scaling/rotation tab can be used to further correct measurements after rewiring

If factors for phases L2 and L3 are same as L1, user can mark the checkmark at the top of the panel and only enter values for phase L1. Fourth channel (U4 or UN) settings are always applied separately.

If phase correction angles are a multiple of 120 degrees, consider using the rewiring tab instead of entering values in degrees, to get the correction applied to harmonic and waveform channels, as explained in the previous chapter.

5.3.6 DIGITAL I/O

If the PMU device contains digital inputs and outputs, it is possible to view their status and manually change output values using the Digital I/O tab. Depending on the device type, different number of inputs/outputs may be shown:

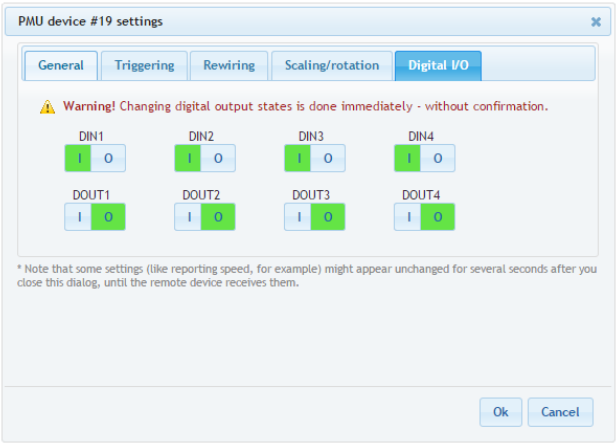


Figure 5.9: Digital inputs and outputs can be controlled using the last tab

5.4 SYNCHRONIZED COMPARISON

To compare real-time synchrophasors of your devices with a synchronized timestamp across all devices, use the **Compare** page, accessible from the navigation menu. Depending on the network conditions, this page will show measurements with a certain delay to ensure phasors from all devices are collected.

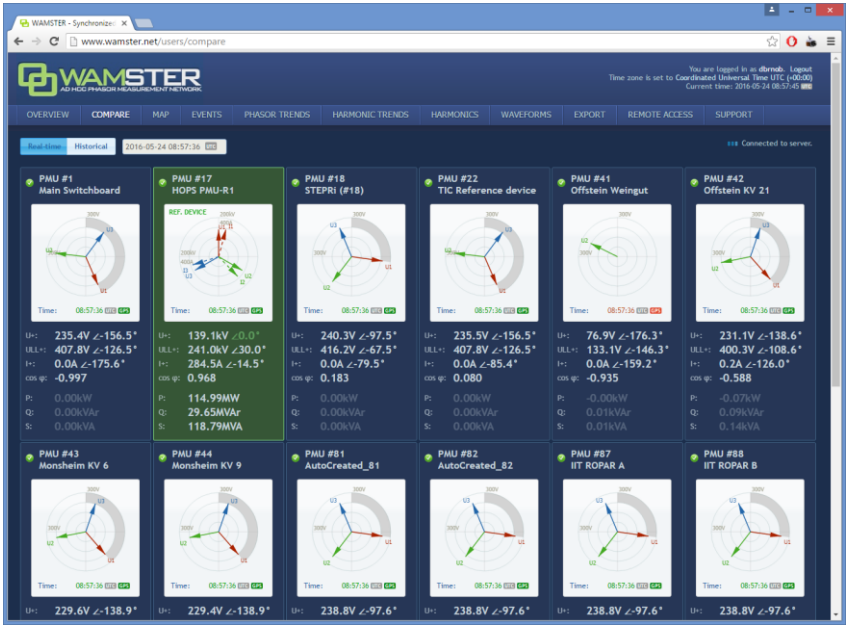


Figure 5.10: Measurement comparison page allows real-time and historical comparison. Selected reference device is shown in green

Each diagram shows voltage and current phasors for the related device, with the angle **relative to the currently selected reference device**. Reference device is shown in green, and the positive symmetry vector for this device is set to 0.0°. Clicking on a different device will set it as the current reference device and all vectors will be rotated accordingly.

Below each phasor diagram there is a table with several measured values: U+ (voltage positive symmetrical component), ULL+ (line voltage pos. sym. component), I+ (current pos. sym. component), cos φ, as well as active, reactive and apparent power.

Current phasor angle is shown relative to the U+ phasor of the **same device** (not relative to the reference device).

To enable better visualization of the relative rotation, positive symmetry angle difference is drawn with a gray arc on each phasor diagram, as seen in the right phasor diagram in the figure below (showing -59° relative angle):

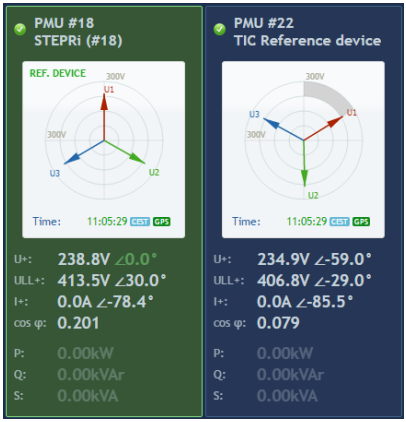


Figure 5.11: Device selected as the reference device (left), and a different device with relatively rotated synchrophasors (right)

5.4.1 SWITCHING BETWEEN REAL-TIME AND HISTORICAL VIEWS

By default, the Compare page shows real-time relative measurements for currently connected devices. In order to freeze the comparison at a specific moment in time, or view historical measurements, it is necessary to switch from Real-time to Historical view using the buttons at the top of the Compare page:

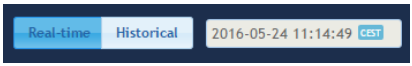


Figure 5.12: To switch from Real-time view to Historical, use the buttons at the top

Once the **Historical view** is selected, the date/time input textbox is enabled for input, and a date/time picker control is shown for easier mouse selection. As the time is modified either using textbox or the sliders below, data is retrieved from the server and displayed in the left and central panels.

Note that Real-time view actually displays measurements with a slightly longer delay (10s). Since communication link between the device and the server can sometimes be slowed down or even disconnected in unreliable GPRS networks, this delay allows the device to connect again and server to retrieve missing frames.

5.5 GEOGRAPHIC LOCATIONS

To view accurate PMU locations on a map, with a possibility to compare measurements, use the **Map** page, accessible from the navigation menu:

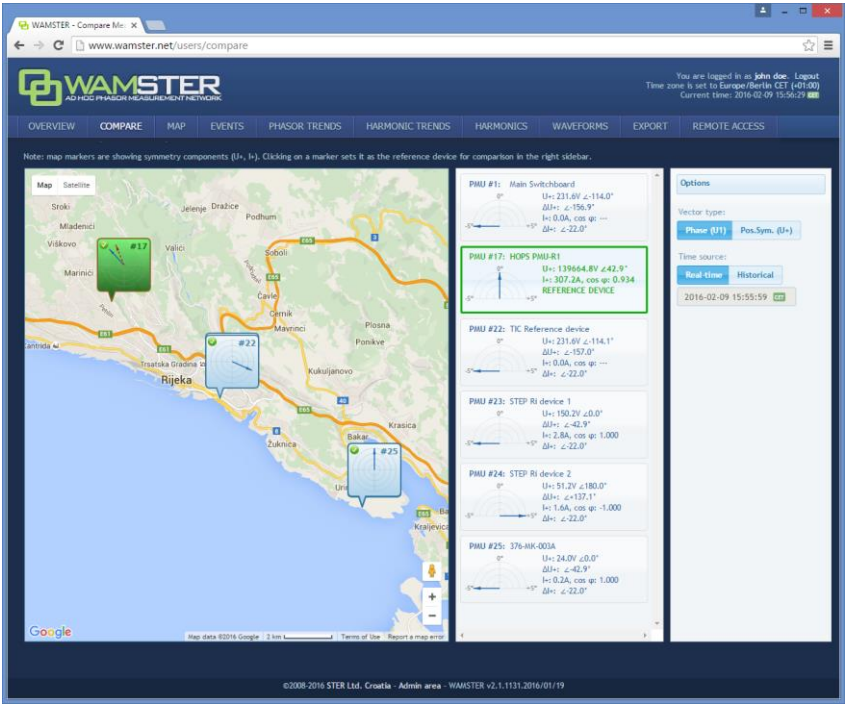


Figure 5.13: Map page allows real-time and historical comparison, with a map showing device locations. Selected reference device is shown in green and can be selected by clicking the entry in the table or on the map.

Left part of the page shows a map with geographical locations of your instruments (as reported by their GPS devices). Each device balloon shows voltage (blue) and current (red) absolute symmetry components, which rotate as the data is received. When a device is clicked, it is marked green and becomes a reference device in the central panel, and other device measurements are displayed relative to the selected device.

Central panel contains a table of devices with actual measurements: absolute current and voltage synchrophasor measurements (positive symmetry components (U+, I+), as well as their relative (ΔU+, ΔI+) angles (compared to the selected reference device marked with green color). Each device entry also displays a visual gauge indicator, showing the relative phasor angle difference (with a fixed range of -5° to +5°).

Note that if a relative difference is larger than ±5°, the gauge is not rescaled to keep the sa other devices. This means that if the gauge is "floored", it may actually represent a differe range.

5.5.1 SETTING THE REFERENCE DEVICE FOR COMPARISON

By clicking on a specific device balloon on the map, or the same device in the central panel, the device is selected as a **reference device**, which is indicated with a green color, as shown below:

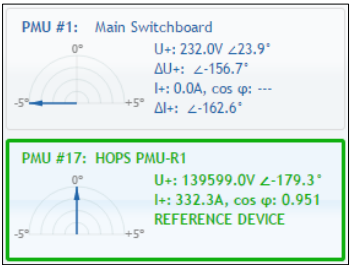


Figure 5.14: Clicking on a device sets is as the reference device, which is indicated with a green border and values shown in green color.

5.5.2 SWITCHING BETWEEN REAL-TIME AND HISTORICAL VIEWS

By default, Map page shows real-time relative measurements for currently connected devices. In order to freeze the comparison at a specific moment in time, it is necessary to switch from Real-time to Historical view using the **right panel** on the Compare page:

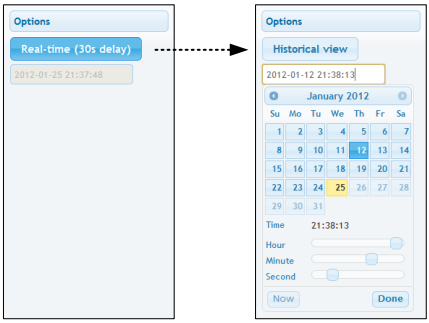


Figure 5.15: Clicking on the Real-time toggle button changes the view to Historical

Once the **Historical view** is selected, the date/time input textbox is enabled for input, and a date/time picker control is shown for easier mouse selection. As the time is modified either using textbox or the sliders below, data is retrieved from the server and displayed in the left and central panels.

Note that Real-time view actually displays measurements with a slightly longer delay (10s). Since communication link between the device and the server can sometimes be slowed down or even disconnected in unreliable GPRS networks, this delay allows the device to connect again and server to retrieve missing frames.

5.6 CONFIGURING AND VIEWING TRIGGERED EVENTS

Event page shows the list of detected (triggered) events and provides the interface for configuring event triggers for PMU devices.

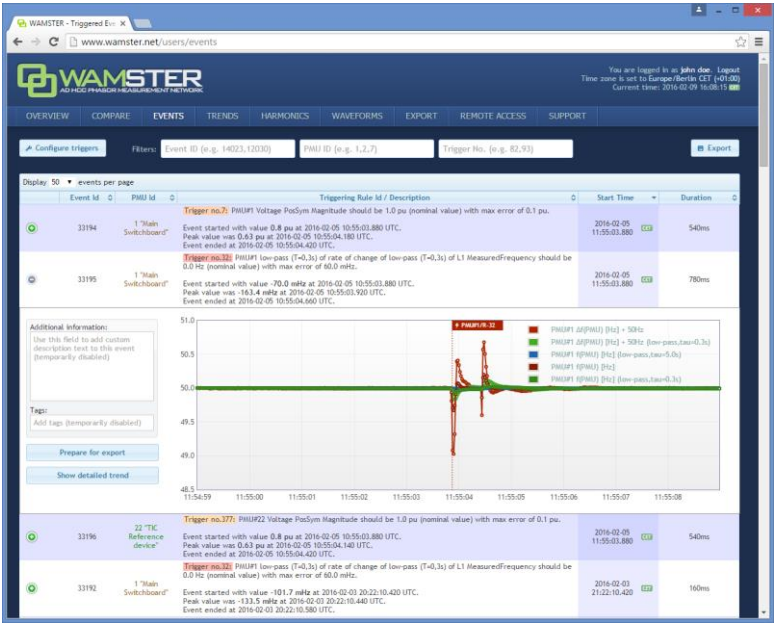


Figure 5.16: List of events. Clicking the green plus-sign button, expands details for the event.

For each entry in the table, user can click the event row (or the green Event details button at the beginning of the row) to show the detailed chart of the quantities which triggered the event. By further clicking on this chart, Trend page will be shown in a separate tab, positioned to the related event, so that the user can further analyze the data and include other channels and devices into the comparison. Trend page allows zooming, panning and various other features as displayed in the following chapter.

Event table can be sorted by different columns by clicking on their column headers, as well as filtered by the event ID, PMU ID, or trigger rule ID. To filter events, use the text boxes above the event table. Each of these text boxes can accept multiple comma separated values.

By clicking the "Configure triggers" link, **Event triggering setup** page is displayed:

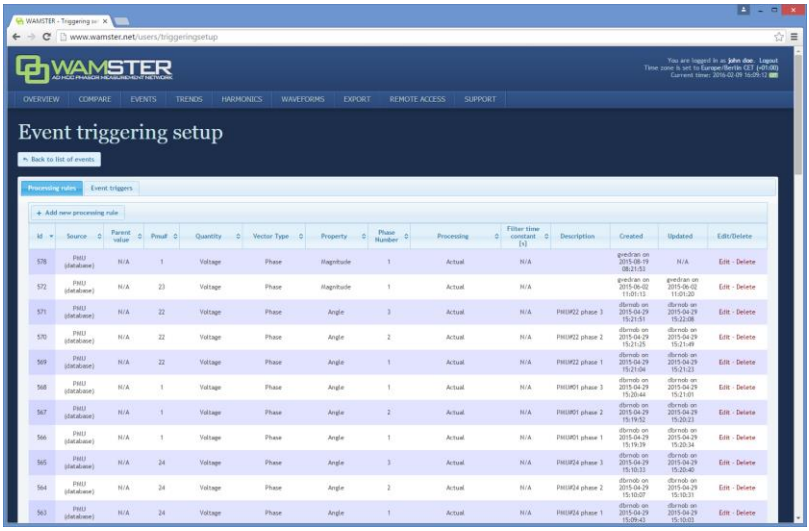


Figure 5.17: Interface for configuring event triggering rules and triggers.

Configuring event triggering consists of two steps:

- **Defining processing rules:** choosing quantities, defining calculations and filters, as well as chaining multiple rules in order to get the processed value for the next step, and

- **Defining event triggers**: choosing a processing rule defined in the first step (or two rules for relative comparison), defining processing rules, hysteresis, preprocessing, and creating thresholds which will trigger the event

Each event trigger can be also be disabled to prevent creating events when the device is not connected or measurements are not yet ready.

5.7 ANALYZING SYNCHROPHASOR TRENDS

Using the **Phasor trends** page, accessible from the top navigation menu, it is possible to quickly view historical trends for all devices, perform measurement comparisons, examine triggered events across multiple devices, and prepare the data for export. If the device functionality supports oscillograms, this page also allows requesting waveforms for certain events of interest.

When the view is zoomed out for more than 60 seconds, data is displayed using aggregates (minimum, maximum, average for each aggregate interval), with the

aggregate interval duration dynamically expanded depending on the zoom level. Each of these intervals (min, avg, max) can be shown or hidden using the toolbar above the chart.

To speed up data retrieval, aggregates are calculated on 1fps data (0 ms frames only). This can sometimes result in different extremes being shown after zooming in to see the actual phasors. Although such subsecond oscillations are not seen at far zoom-out levels, they can be easily spotted using event annotations placed across the chart.



Figure 5.18: Trends page can be used to view and compare measurements during different time periods

Trends page components:

1	Data settings sidebar	Left settings sidebar contains input boxes for basic chart data settings, and the “Update charts” button which reloads the chart using specified settings.
2	PMU device selection tree	This tree contains all PMU devices registered for the currently logged in user, grouped by their current campaign (project). Checking the device will include its channels in the chart display. By checking the campaign, it is also possible to select multiple devices at once.

3	Channels selection tree	This tree contains a list of all channels. Checking a channel will include data from this channel from all selected PMU devices in the chart.
4	View settings toolbar	Top toolbar contains buttons for adjusting the chart view (toggling individual min/max/average aggregate channels, zooming and panning, setting zero-offsets, toggling histograms), as well as the Online button for enabling the chart to be automatically refreshed every 5 seconds, and buttons for creating export and waveform download requests.
5	Charts	This area shows the charts using the chosen settings, after clicking “Update charts”.

5.7.1 DATA SETTINGS SIDEBAR

Left settings sidebar contains tools for defining basic chart settings:



Figure 5.19: Left settings sidebar

After changing any of the settings, the chart is not refreshed until you click the Update charts button.

1	Start time/End time	These textboxes can be used to specify the time range manually. Time is specified in the time zone currently selected in the login status area (top right area of the screen). Moving around the chart can usually be done quicker by selecting an area on the chart using the mouse, or clicking on the chart to center it, or using the zoom/pan toolbar above the chart.
2	Reference PMU	When comparing phasor angles between multiple PMU devices, it is often desirable to display them relative to a single PMU device. This dropdown will show a list of all currently selected PMU devices.

3	Reference phase	If multiple phase channels are selected (e.g. L1 angle and L2 angle) between multiple PMU devices, each phase will be shown on a separate chart. Using this setting, it is possible to set all chart to display angle data relative to a certain phase, or each chart to show separate phase data. If the Reference PMU is not set, then each PMU device will have its own reference phase. If the Reference PMU is set, then all PMUs will use the single phase channel from the reference PMU.
4	Current phase	Current phase channels (current phasor angles) are always displayed relative to their corresponding voltage channels; i.e. I1 angle is always displayed relative to U1 angle. This setting allows you to set make all current angles be shown relative to the reference PMU. If the reference PMU is not selected, this option will be disabled.
5	Time quality	By default, Wamster will only show measurements with fully locked GPS signal. If there are measurements where GPS signal was lost, there will be gaps in the chart at these ranges. Using this setting, it is possible to show all measurements, even those where time was not fully synchronized with the GPS.

5.7.2 VIEW SETTINGS TOOLBAR

View settings toolbar is placed above the chart and contains additional options and actions:



Figure 5.20: Top chart toolbar

1	Min/Avg/Max button group	When the chart is zoomed out and displayed time range is larger than 2 minutes, data is displayed as aggregates (minimum, average and maximum value for each aggregate interval). Individual intervals can be shown or hidden by clicking these buttons.
2	Pan and zoom buttons	Using these buttons, it is possible to zoom in and out of the chart, as well as pan (move) the chart in time. Note that y-axes are always scaled dynamically, depending on the currently displayed signals.

3	Z/O (Zero Offset) button	This button offsets all displayed channels, using the first displayed measurement value as the offset, so that all displayed trends start at the zero y-axis value. This is useful for comparing trends which are mutually offset by a large value. When Z/O is active, chart legend will show the offset value next to each channel. When data samples are hovered with the mouse pointer, channel name will also indicate the offset for the hovered channel.
4	V/G (Vector Group) button	Vector group works similar to the Z/O (zero offset) button, but is applied to angle (phase) channels only and rounds offsets to the nearest transformer vector group (hour-clock number), i.e. an angle multiple of 30°. This is useful when comparing phasor angles from multiple PMU devices from different vector groups.
5	PU (Per Unit) button	When enabled, voltage magnitudes are shown in p.u. (per unit) values (factor of nominal voltage), instead of volts.
6	H (Histogram) button	Toggles the display of histogram charts. If enabled, for each shown time series chart, a histogram is shown, showing the distribution of values displayed in the chart.
7	Online button	Toggles the “Online mode”, where the chart is repeatedly updated to show most recent measurements. While this mode is active, it is still possible to select other settings, devices and channels. Zooming in or out of the chart will turn Online mode off.
8	Export button	Opens the Export page in a new tab, with currently shown devices and time range selected for CSV export.
9	Wf request	Creates a new waveform download request, for the first second shown in the chart, and opens the Waveforms page in a new tab.

5.7.3 CHART INTERACTION

If using a PC to analyze data, parts of the chart can be zoomed in or centered using a mouse:

- To zoom in on a part of the chart, move the mouse over the chart and hold the left mouse button while dragging to select the area. After releasing the button, chart will be refreshed to show the selected area.
- If Ctrl button is held while selecting the area, zoomed chart will be shown on a different tab.
- Clicking on a point on a chart will move the center of the chart to the clicked timestamp.

If using a tablet or a phone to analyze data, chart can be zoomed/panned using the toolbar buttons, or centered by tapping on the chart (similar to left clicking the chart).

5.7.4 CHART ANNOTATIONS

Triggered events and downloaded waveforms are annotated on the chart as colored tags. Event tags are shown at the top of each chart, while waveforms are shown at the bottom. Hovering an event tag shows event information:

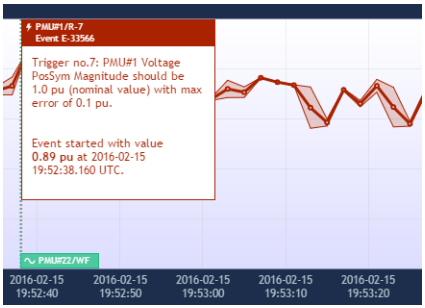


Figure 5.21: Hovered event tag shows event information

Clicking on the waveform tag opens the corresponding waveform in a new tab.

5.8 WAVEFORMS/OSCILLOGRAMS

Waveforms page shows a list downloaded oscillograms, grouped by timestamp in the table view on the left side. Clicking on each entry in the table shows the oscillograms in the right side chart.

Similar to the trends page, by selecting the area on the oscillogram chart (by clicking and dragging using the mouse), it is possible to zoom in the range. After zooming in, selecting a different device in the same group will show the data for that device, but keep the displayed zoom range, which allows easier comparison of device measurements within a group.



Figure 5.22: Waveforms page

5.9 HARMONICS

Harmonics page shows downloaded voltage and current harmonic aggregates (minimum, average, maximum), for 10-minute aggregate intervals. These measurements are automatically downloaded from each device with the supported firmware version, at the end of each aggregation interval.

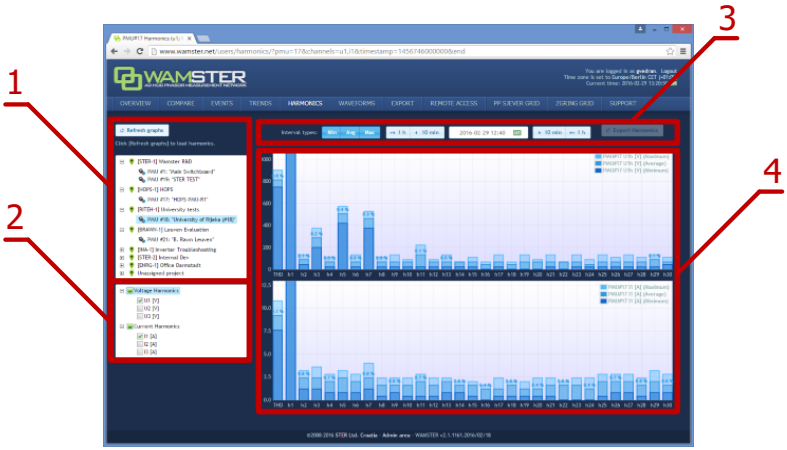


Figure 5.23: Harmonics page provides interaction elements similar to the Trends page

Harmonics page components:

1	PMU device selection tree	This tree contains all PMU devices registered for the currently logged in user, grouped by their current

		campaign (project). Selecting a single device will include its harmonic channels in the chart display, after clicking "Refresh graphs".
2	Channels selection tree	This tree contains a list of voltage and current phases. Checking a channel will include data from this channel in the chart. Some devices might not have all voltage and current channels enabled, depending on their settings.
3	View settings toolbar	Top toolbar contains buttons for adjusting the chart view (toggling individual min/max/average aggregate channels, setting the timestamp and moving in 10 min. or 1 hour intervals, and exporting the harmonics data.
4	Charts area	This area displays harmonics using the specified settings, after clicking "Refresh graphs".

Harmonic bars are shown as percentages of first harmonic (H1). Minimum, average and maximum values in actual units (volts or amperes) can be shown by placing the mouse pointer over each bar in the harmonics chart, which will display a tooltip with additional information.

5.10 HARMONIC TRENDS

Similar to the Phasor trends page, the Harmonic trends shows charts for 10-min. harmonic aggregates. After selecting the time range, one or more PMU devices, and one or more harmonic channels for display, clicking the Update charts button shows the harmonic trend for these parameters:

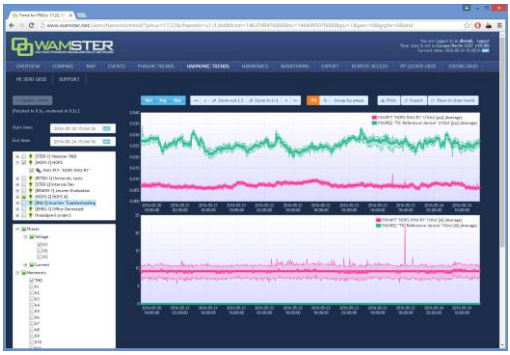


Figure 5.24: Waveforms page

Charts can be panned and zoomed, like explained in chapter 5.7 *Analyzing synchrophasor Trends*.

5.11 EXPORTING AND DOWNLOADING DATA

To export the data from the cloud storage and download it to your computer, select the **Export** page from the navigation menu. On the left side of the page, there is panel for creating new export requests, which allows you to specify the time range for export, export resolution in frames per seconds, and individual devices for which the measurements should be exported.

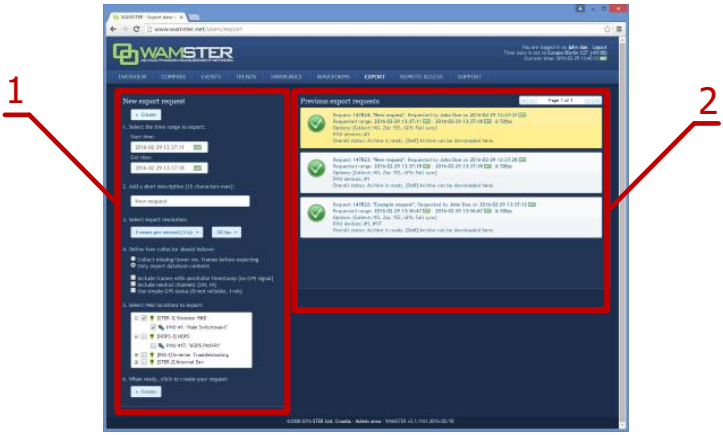


Figure 5.25: Data export page: left panel shows export options, right panel shows previous export requests

If the export resolution is higher than the default reporting resolution for a given device, you can also specify whether the server should request these "missing" frames from each device, or not. If your devices are configured to report on a lower speed, and you would like to get a detailed snapshot of a certain time range, you can choose the option to collect those frames.

Export inputs:

1	Time range	Time range defines inclusive start and end timestamps for the request, in the currently selected time zone.
2	Short description	Exports can be given a short descriptive name to easily differentiate them.
3	Export resolution (fps)	Export resolution can be specified in fps (frames per second) or by time intervals (seconds between frames).
4	Export settings	Various export settings, described in the following table.
5	PMU devices selection tree	List of PMU devices for the currently signed in user, grouped by project/campaign.
6	“Create” button	Sends the export request to the server.

Export settings:

1	Collect missing/ lower res. frames before exporting	If this option is selected, all data which was collected at lower resolution that specified in the export options will be recollected from the device before exporting.
2	Include frames with unreliable timestamp	By default, frames with unreliable time sync are not included in the export. However, since PMUs are equipped with internal clocks, even after losing the GPS signal, quality of the timestamp might still be good enough for the export. Checking this option will include all frames in the export, regardless of the GPS/time source status.
3	Include neutral channels	Checking this option will include U4 and I4 in the export. Leave unchecked if these channels are not physically connected.
4	Use simple GPS status	If checked, GPS column will contain 1 for full time synchronization, and 0 for all other cases (broken cable, unreliable GPS, invalid timestamp, etc). If the "Include frames with unreliable timestamp" option is checked, this option will allow easier differentiation between valid and invalid timestamps. If unchecked, GPS column will contain Wamster-specific GPS flags.

Once the export request is added, it can be canceled, but not modified. If the request is configured to collect all missing frames from the device before exporting, all devices will have to send all requested frames before the export file is completed. Additionally, requests which need to collect more than 15 minutes of data are placed in a lower-priority queue; depending on the mobile network connection type and speed, requests may take significant time to complete.

Since export requests tend to contain large amounts of data, server queues requests and processes them sequentially. Since this may take some time to complete, all requests for a given user (and their current progress statuses) are shown in the right panel on this page. This means that users can queue export requests, log out of the system, and then return later to download the file to their PCs.

Previously finished requests are also available for download, for up to 1 week after creating the request. After 1 week exported files are deleted to conserve server space, but each file can be recreated if needed.

Data is currently exported in a CSV (comma-separated values) textual format. For information on customization of the format or implementation of other formats, contact support@wamster.net.

5.12 REMOTE ACCESS

For additional configuration options, as well as diagnostics and troubleshooting, Wamster allows each device to be accessed remotely through the **Remote Access** page:

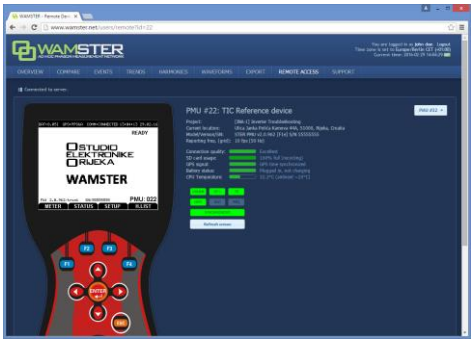


Figure 5.26: Remote access page

Clicking on individual keys on the instrument mask sends these commands to the instrument, while the instrument sends its current screen back to your browser. To prevent a large number of missing frames whenever the screen is changed on slower (GPRS) networks, screen refresh can be only initiated **manually**, by clicking the **Refresh screen** button.

For this reason, when a different screen is selected on the instrument and it differs from the currently displayed image in the browser, status indicator above the Refresh screen button changes from **Synchronized** to **Not synchronized**:

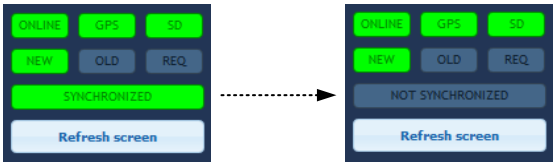


Figure 5.27: If the remote instrument is in a different menu than the one shown on the web page, remote status will change to "NOT SYNCHRONIZED"

Note that "SYNCHRONIZED" status does not necessarily mean that remote instrument screen is showing exactly the same contents as the web page, it only indicates that the same submenu is selected as currently shown. Remote access functionality allows access to the device for extraordinary cases, without drastically impairing the instrument's primary functionality.

5.13 SUPPORT PAGE

Being an online application, Wamster allows download of documents applicable to devices associated with your username. Latest version of each manual is available on the **Support** page, accessible through the navigation menu.

6 Notes